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Amendments to Specification

Please correct numbered paragraph [0015] as follows:

-- [0015] The invention provides a correlation-based matrix ~~is~~ generated using zero-lag auto and cross-correlations of signals commonly found in echo cancellers. --

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Please amend numbered paragraph [0020] as follows

-- [0020] The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which;-

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Figure 1 is a schematic diagram of an echo canceller using LMS Adaptive Filtering; and

Figure 2a is a plot showing the value of det [R] under normal convergence;

Figure 2b is a plot showing the value of det [R] with a path change; ~~and~~

Figure 2c is a plot showing the value of det [R] with double-talk; and

Figure 3 illustrates the process of detecting double-talk. --

Please replace the numbered paragraphs [0023], [0024], [0029], [0030], [0031], [0033], [0037], [0038], [0039] with the following new paragraphs as follows. In each case the superfluous μ has been deleted:

-- [0023] The preferred embodiment of the algorithm for this patent uses the Normalized-LMS (N-LMS) algorithm. Mathematically, the adaptive filter tap-weight update procedure for the N-LMS algorithm consists of the following three equations

$$\hat{d}[n] = \hat{w}^{H}[n]u[n]$$

$$e[n] = d[n] - \hat{d}[n]$$

$$\hat{w}[n+1] = \hat{w}[n] + \frac{\mu}{a + \|u[n]\|^{2}} u[n]e[n]$$

--

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-- [0024] where

$u[n] = R_{IN}$ = echo source signal

$\hat{w}[n]$ = LMS filter coefficients

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$d[n] = S_{IN}$ = desired LMS output (echo + double-talk)

$\hat{d}[n]$ = LMS output (estimated echo)

$e[n] = S_{OUT}$ = LMS error signal

μ = LMS step-size parameter

a = A small constant (provides numerical stability). --

-- [0029] Consider two signals, $X_0[n]$ and $X_1[n]$ generated by a linear combination of two real-valued source signals, $S_0[n]$ and $S_1[n]$. Mathematically, this mixing process may be described as

$$X_i = H_{i,0} \cdot S_0 + H_{i,1} \cdot S_1, \text{ --}$$

-- [0030] where $H_{i,j}$ are the mixing coefficients. In matrix form, this may be written as

$$\mathbb{X} = \mathbb{H} \cdot \mathbb{S} \text{ --}$$

-- [0031] where

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$$\mathbb{X} = \begin{bmatrix} X_0 \\ X_1 \end{bmatrix}, \mathbb{H} = \begin{bmatrix} H_{0,0} & H_{0,1} \\ H_{1,0} & H_{1,1} \end{bmatrix} \text{ and } \mathbb{S} = \begin{bmatrix} S_0 \\ S_1 \end{bmatrix} \text{ --}$$

-- [0032] A matrix $\mathbb{R}$ is defined as

$$\mathbb{R} = E\left[\mathbb{X}\mathbb{X}^T\right] \text{ --}$$

-- [0033] where E[...] is the statistical expectation operator. $\mathbb{R}$ may be expanded in two ways

$$\mathbb{R} = E\begin{bmatrix} X_0 X_0^T & X_0 X_1^T \\ X_1 X_0^T & X_1 X_1^T \end{bmatrix}$$

$$= E\left[\mathbb{H}\mathbb{S}\mathbb{S}^T\mathbb{H}^T\right] \text{ --}$$

-- [0036] The way in which the matrix can be used to perform double-talk and path change detection will now be explained. First, suppose we generate the signal mixtures in using convolutions:

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$$\mathbb{X} = \mathbb{H} \otimes \mathbb{S} \text{ --}$$

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-- [0037] Now the terms in the mixing matrix can be vectors. We further impose the condition that $\mathbb{H}$ have the following form:

$$\mathbb{H} = \begin{bmatrix} H_{0,0} & 1 \\ H1,0 & 0 \end{bmatrix}$$ --

-- [0038] With $\mathbb{H}$ defined in this way, it is now possible to connect the terms in the preceding equations with the parameters available in the echo canceller layout shown in Figure 1. Let

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S_0 = echo source signal = $R_{IN} = u[n]$

S_1 = doub c-talk signal

$H_{0,0}$ = echo path

$H_{1,0}$ = LMS filter coefficients = $\hat{w}[n]$

--[0039] With these definitions, it is apparent that

$$X_0 = H_{0,0} \otimes S_0 + S_1 = S_{IN} = d[n]$$

$$X_1 = H_{1,0} \otimes S_0 = \hat{d}[n]$$

As shown in Figure 3, in practising the invention, a first step 10 is performed to generate the correlation-based matrix **R** from X_0 and X_1. A matrix operation 11, for example, forming the determinant is next performed on the determinant, and the result of the matrix operation is then examined at step 12 to detect double-talk and path changes. In the case of the determinant, this is compared with a threshold value. --